

MEEM 3700
Mechanical Vibrations

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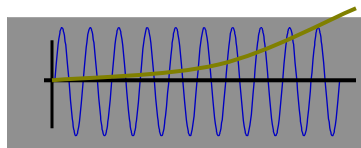
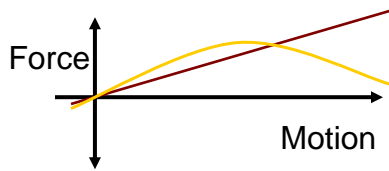
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	No Forces	Forces
No Motion	Who Cares?	Statics
Motion	Kinematics	Dynamics

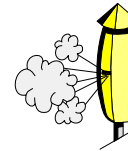
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Dynamics

- Linear —
- Non-Linear —
- Arbitrary motion —
- Harmonic Motion —



Mechanical Vibrations
Sound (Acoustics)



Building on the Past

Dynamics and Kinematics (MEEM 2700)

Strength of Materials (MEEM 2150)

Thermodynamics (MEEM 2200)

Differential Equations (MA3521)

Vibration in Our Lives

Our heart beat, our lungs oscillate, we hear because our ear drum vibrates...
Vibration even makes us snore!!



The light waves which permit us to see & sound waves through which we hear entail vibration

We cannot even say "Vibration" without vibration of larynges, vocal cord

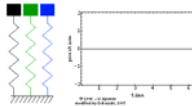


We move by oscillating our legs



We limit our discussion to "MECHANICAL VIBRATION"... i.e. Vibration of Dynamic Systems

What is a Dynamic System??? Any System that contain Mass and Elasticity



Vibration: Friend or Foe??

Friend

- Conveyors, Hoppers, Compactors, Pneumatic Drills, etc.
- Opening of a cork from a wine bottle
- Washing Machine
- Mechanical Shakers, Mixers, Sieves, Sorters, etc.
- Musical Instruments
- Clocks, Watches
- Medical Field – Massagers, etc.

Foe

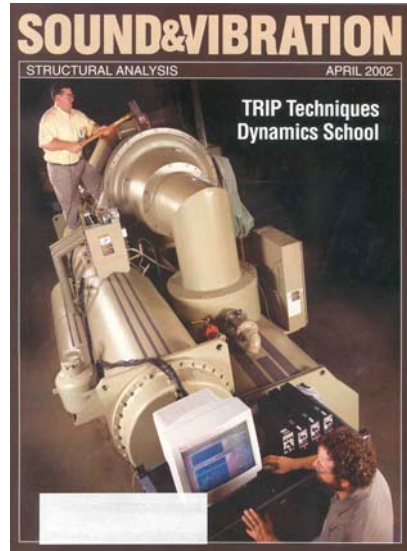
•RESONANCE – RESONANCE – RESONANCE

Tacoma Narrows Bridge

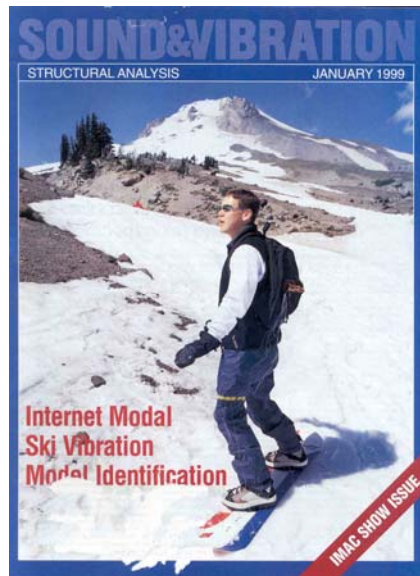


- Similar problems in machine tools, vehicles, turbines, pumps, compressors, buildings, aircraft & spacecraft systems
- Excessive vibration leads to loosening on parts, noise & eventual failure
- Effects of vibration on human body: Discomfort, Fatigue, Loss of Efficiency
- Sound quality in products

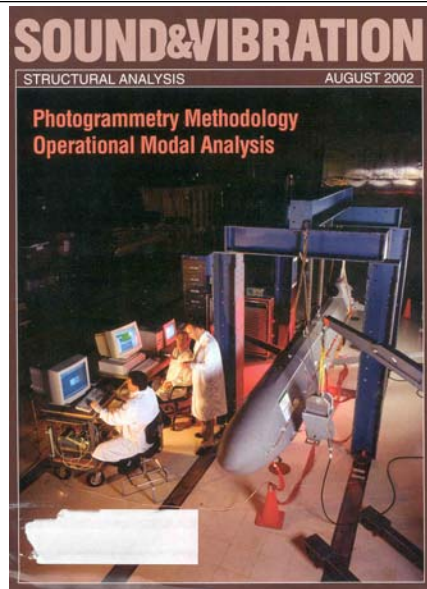
Vibrations in Machinery



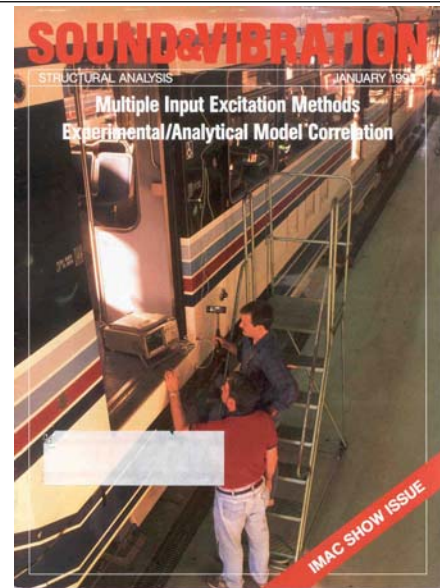
Vibrations in Recreation



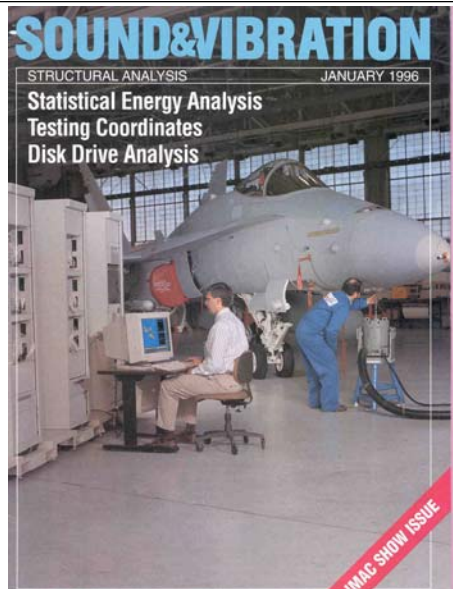
Vibrations in Defense



Vibrations in
Transportation



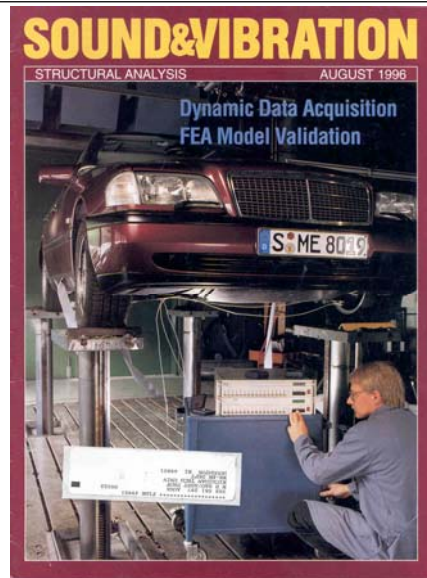
Vibrations in Aerospace



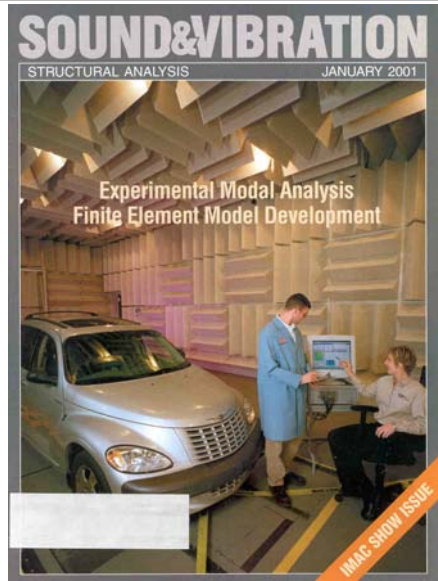
Vibrations in Automobiles

➤ NVH (Noise, Vibration, & Harshness) is a Top Priority for the BIG 3 Auto Industry.

➤ Several hundred million dollars have been invested in infrastructure & human resource development in this area over the past 10 years.

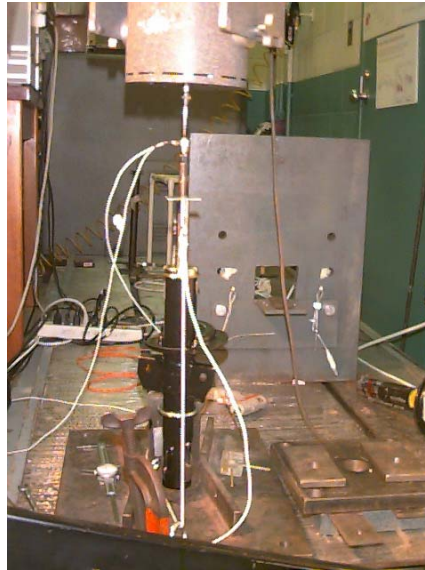


Sound/Noise in
Automobiles

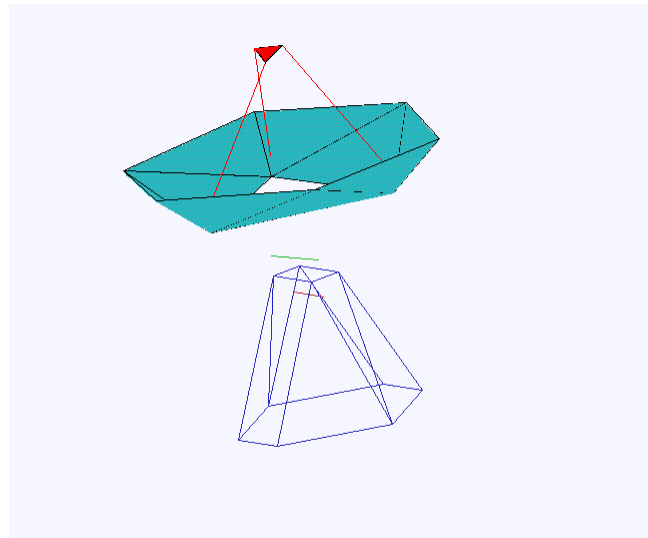
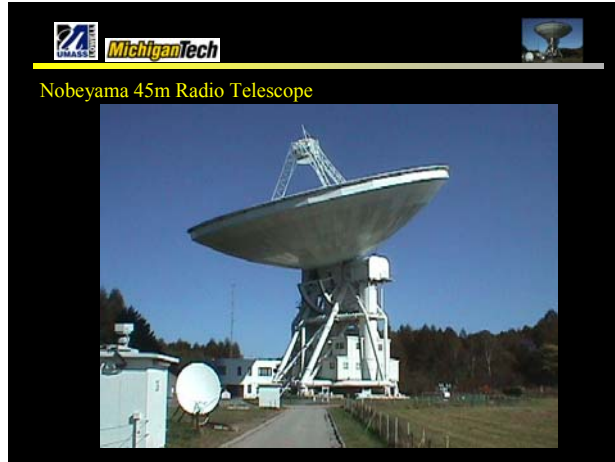


Research in the Dynamic
Systems Laboratory

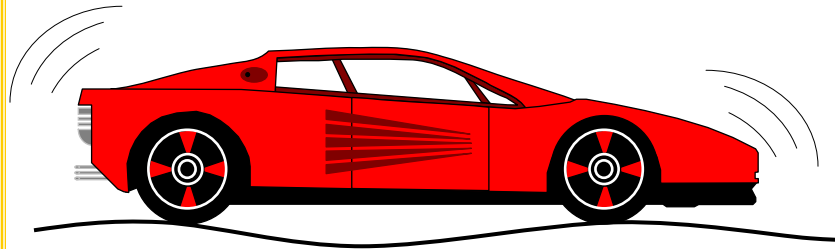
Damping
Characterization



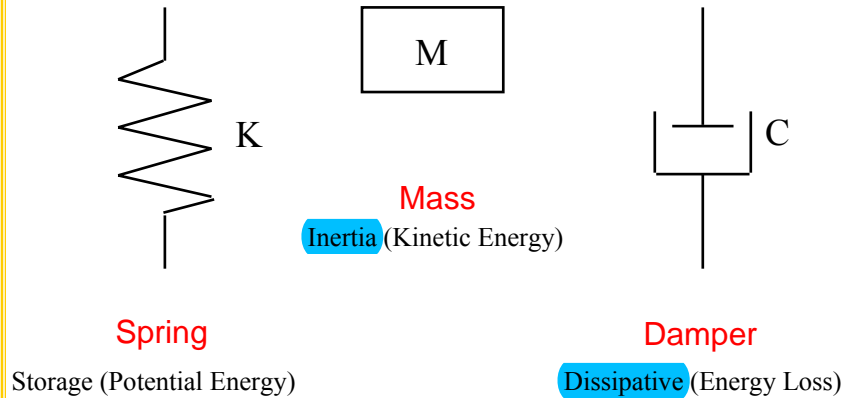
Research in the Dynamic Systems Laboratory



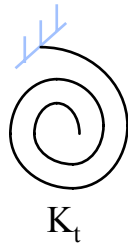
Modeling Dynamic Systems



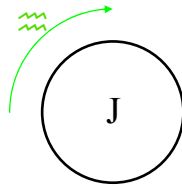
Vibrating Systems: Translational Elements



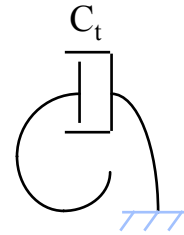
Vibrating Systems: Rotational Elements



Torsional Spring

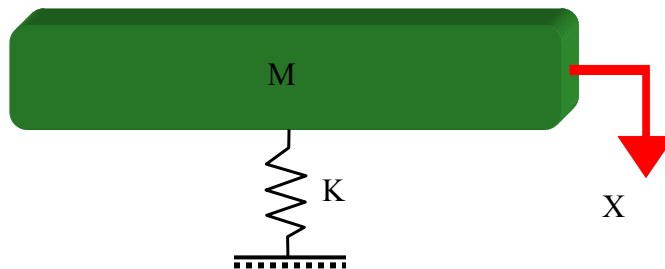
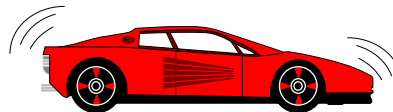


Rotating Inertia

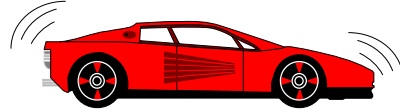


Torsional Damper

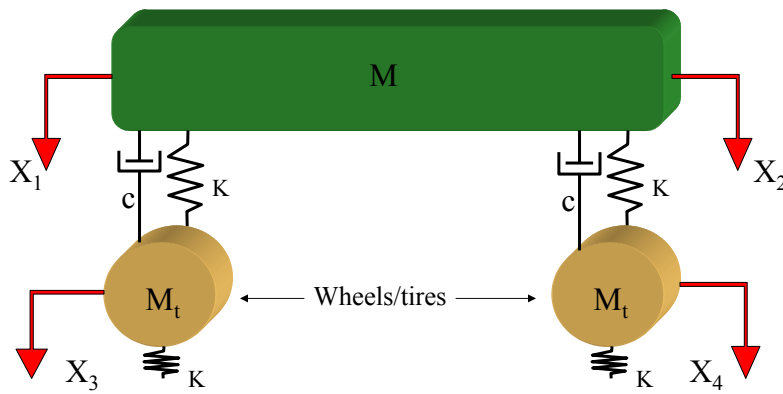
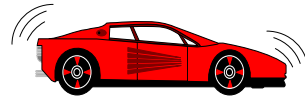
Vibrating Systems: Single Degree of Freedom (SDOF)



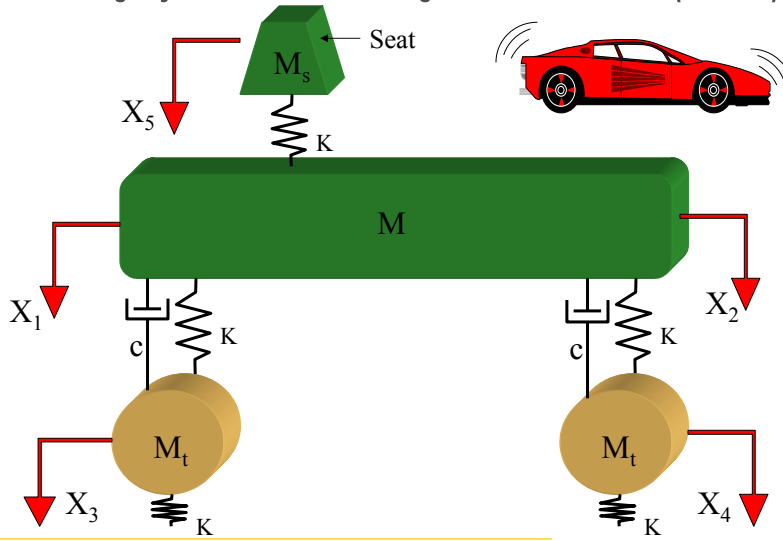
Vibrating Systems: Multi Degree of Freedom (MDOF)



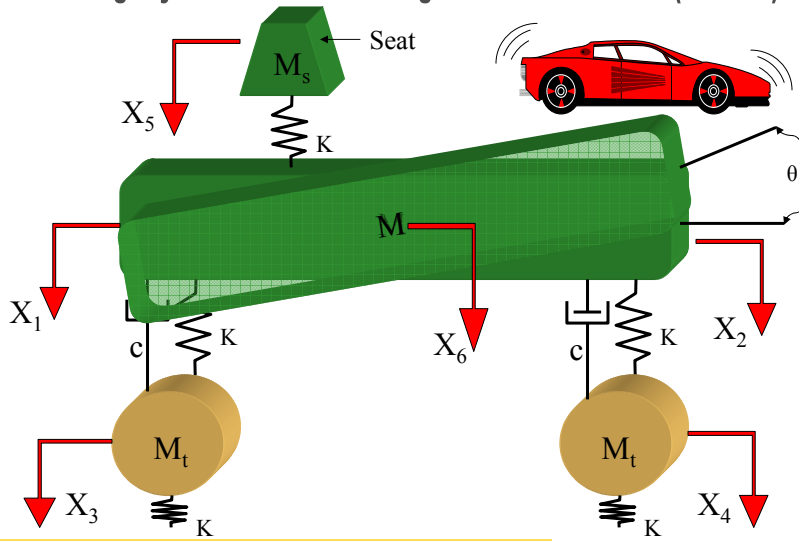
Vibrating Systems: Multi Degree of Freedom (MDOF)



Vibrating Systems: Multi Degree of Freedom (MDOF)



Vibrating Systems: Multi Degree of Freedom (MDOF)



Vibrating Systems: The Human Body



Fig. 1.6. A simplified, multiple, discrete mass-spring-damper model of a human body standing on a vibrating platform.

